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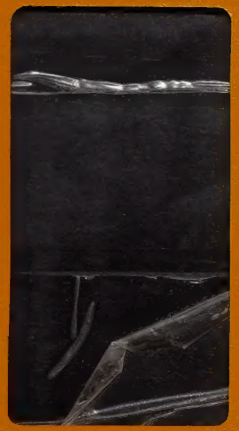

INSTRUCTION MANUAL

MODEL RS40-5

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SYSTRON DONNER CORPORATION

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SECTION I - DESCRIPTION

1.1 INTRODUCTION

The Silicon Rack Series power supply is a flexible and dependable source of D.C. power which can be used to meet a variety of needs ranging in scope from inspection and production testing, to laboratory bench testing and systems applications.

The wide range of outputs available makes this unit well suited for use as a basic laboratory power source. The ability to provide power packaged in minimum space with high reliability meets the demands of most systems requirements.

All components used in the construction of the Silicon Rack units are of the highest quality available, and have been subjected to 100% incoming inspection.

Each electrolytic filter capacitor is of computer grade, and has been quoted by the manufacturer as having a life expectancy exceeding ten (10) years. All semiconductors are silicon for high temperature operation, and permit fully reliable operation at ambient temperatures up to 71°C without any derating, addition of heat sinks or forced air cooling. Each power transistor has been generously "derated" and temperature aged to provide high reliability. All rectifiers are hermetically sealed silicon types, and all zener diodes have been temperature stabilized.

1.2 GENERAL FEATURES

Output, Sensing and Remote Voltage Programming terminals are located on terminal boards mounted on the rear panel of the unit. The power switch, power on indicator light, mode indicator light, current and voltage controls and appropriate

metering devices are all located on the front panel. For convenience, additional output terminals have been provided on the front panel.

1.2.1 Constant Voltage Mode

A constant voltage is maintained across the output terminals at any preset value from zero to rated voltage output, provided that the load does not draw more than either the rated output current or more than the preset limiting current value determined by the front panel current control settings.

1.2.2 Constant Current Mode

Constant current operation is achieved by maintaining a constant voltage across an internal current sensing resistor. An automatic cross over network changes the mode of operation from Constant Voltage to Constant Current when the current demand reaches that of the preset current adjust control. The point at which the operating mode automatically changes is a function of variations in load conditions. The cross over point is adjustable, and can be established anywhere within the current and voltage range of the unit.

1.2.3 Automatic Current Limiting

Short circuit protection is provided by the Automatic Current Limiting circuit which limits the maximum output current under all load conditions. The point at which automatic current limiting occurs is variable, and may be selected anywhere from 1% of the rated current to the full rated current output of the unit. In the event of a short circuit, the output voltage drops to zero, and returns to normal only when the short circuit is removed.

1.2.4 Mode Indicator

A front panel mode indicator light indicates when the

1.2.4 Mode Indicator (Cont'd)

unit is operating in either the constant current or current limiting mode of operation.

1.2.5 Automatic Overvoltage Protection (Optional Feature)

Automatic Overvoltage (OV) Protection is available as an option wherein special circuitry automatically tracks the programmed output voltage and prevents it from exceeding this output voltage. The voltage differential that will cause the OV to trip is approximately 10% or 1.5 volts above the programmed voltage. An internal sensitivity control is provided to desensitize the overvoltage protection circuit.

1.2.6 Remote Programming

Remote Programming is provided in the voltage mode of operation. Output voltage may be remotely programmed over its entire operating range. The scale factor for Remote Voltage Programming is 100 ohms per volt.

1.3 PRECAUTIONARY MEASURES

1.3.1 Wire Size

To assure proper regulation under all load conditions, and to prevent severe distortions of the AC line voltage, it is very important to take into consideration the physical size and current handling capabilities of the input power line. Serious losses in regulation and an increase in ripple may result from underrated or overloaded AC input lines. The maximum AC impedance from the breaker box to the power supply input should not exceed 0.75 ohms.

1.3.2 Voltage Regulator and Inverter Inputs

Do not use voltage regulators or inverters as a primary power source. The outputs of these devices are usually not

1.3.2 Voltage Regulator and Inverter Inputs (Cont'd)

sinusoidal in nature, and if used as the AC source for the power supply, will cause serious loss of regulation of the power supply output. Capacitive input filtering used for semiconductor power supplies requires charging to the peak of the rectified AC wave which non-sinusoidal AC sources cannot provide.

1.3.3 Variable Transformer Input

If a variable transformer is to be used to test the power supply for low and high AC line operation, it must be able to supply at least twice the VA requirements of the power supply and load.

1.3.4 Systems Considerations

In systems applications it is recommended that each power supply input power line be run separately to the AC distribution box, in order to minimize cross coupling and interaction between equipment. Do not run sensitive signal leads such as the remote sensing leads in the same cable as the AC input without shielding. It is strongly recommended that the AC input cables should not be run in close proximity to the output load cable leads, if minimum ripple is desired.

1.3.5 Terminal Post Resistance

All terminals and shorting links serving Outputs, Sensing and Programming must be securely tightened before use. Serious loss of regulation and an increase in ripple can result due to a voltage drop caused by loose terminals and shorting links.

1.4 SPECIFICATIONS

Applicable electrical and physical specifications for this unit appear on the following Trygon Specification sheet.

TRANSISTORIZED POWER SUPPLIES

SILICON RACK SERIES

CONSTANT VOLTAGE/CONSTANT CURRENT

RS Series

OUTPUT: 0-20 VDC/0-40 VDC/0-60 VDC/ 0-160 VDC/0-320 VDC

REGULATION, LINE: 0.01% or 3 mv

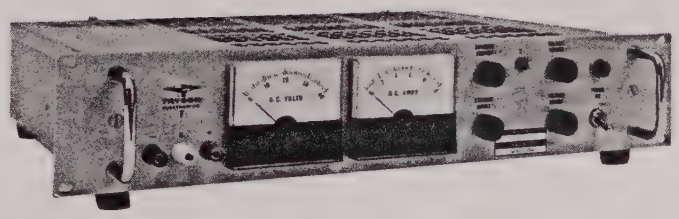
LOAD: 0.01% or 3 mv

RIPPLE: Less than 0.5 mv RMS

INPUT: 105-125 VAC, 55-65 cps

FEATURES

- ALL SILICON DESIGN
- +71°C OPERATION WITHOUT DERATING
- MODE INDICATOR LIGHT
- AUTOMATIC SHORT CIRCUIT PROTECTION
- REMOTE VOLTAGE PROGRAMMING
- REMOTE SENSING
- SERIES OR PARALLEL OPERATION
- NO TURN ON/TURN OFF TRANSIENTS



ELECTRICAL SPECIFICATIONS

CONSTANT VOLTAGE MODE WITH ADJUSTABLE CURRENT LIMITING

Input: 105-125 VAC, 55-65 cps. (200-240 VAC, 50, or 400 cps available).
Output: Floating; isolated from ground, 300 VDC max.
Regulation, Line: 0.01% or 3 mv,* for 105-125 VAC line change at any output without specifications.
Regulation, Load: 0.01% or 3 mv,* no load to full load at any output within specifications.
Ripple: Less than 0.5 mv RMS.
Stability: 0.05% or 18 mv* for 8 hours after warm-up. Measured at constant line voltage, load and ambient temperature.
Temperature Coefficient: (0.02% + 400μv)/°C.
High Stability Option (X): 0.01% or 2 mv* with a T.C. of (0.01% + 100μv)/°C.
Temperature Range: —20°C to +71°C†.
Recovery Time: 25 microseconds to recover within 0.05% or 15 mv* of output voltage for 100% step change in rated load.
Short Circuit Protection: Automatic Adjustable Current Limiting (ACL) variable from 1% to 100% of rated current.
AC Power Input Protection: Fuse.
Remote Programming: All units remotely programmable over output voltage range. Scale factor approximately 100 ohms/volt.
Remote Sensing: Maintains rated regulation directly at the load. Maximum line drop 0.5 volts per leg.
Voltage Adjustment Range: Continuously adjustable concentric vernier controls.

CONSTANT CURRENT MODE WITH ADJUSTABLE VOLTAGE LIMITING

Current Range: 1% to rated current output.
Voltage Compliance: 0 to rated output voltage.
Regulation, Line: 0.5% I_{rated} for 105-125 VAC line change at any output within specifications.
Regulation, Load: 0.5% I_{rated} output current change for the maximum change in load resistance within the rated voltage compliance range.
Ripple: 0.25% or 5 ma*.
Stability: 0.5% I_{rated} for 8 hours after warm-up. Measured at constant line voltage, load and ambient temperature.
Temperature Coefficient: 0.1% I_{rated}/°C.
Remote Programming: Fully programmable over complete current range. Programming resistance $R_{pgm} = 100\ (1\text{-}I_{load}/I_{rated})$.

*Whichever is greater.
†When stacked without free air circulation temperature should be limited to +60° C.

TABLE 1

Model	Volts	OUTPUT Amps	*Impedance DC-1KC	DIMENSIONS W	H	D	Weight (lbs.)
RS20-7.5A	0-20	0-7.5	0.002	19	3½	14⅝	42
RS20-15A	0-20	0-15	0.001	19	3½	14⅝	47
RS40-5A	0-40	0-5	0.004	19	3½	14⅝	43
RS40-10A	0-40	0-10	0.002	19	3½	14⅝	45
RS60-7.5A	0-60	0-7.5	0.004	19	3½	14⅝	47
RS160-1A	0-160	0-1	0.008	19	3½	14⅝	45
RS160-3A	0-160	0-3	0.005	19	3½	14⅝	49
RS320-1A	0-320	0-1	0.016	19	3½	14⅝	49
RS320-1.5A	0-320	0-1.5	0.020	19	3½	14⅝	49

*Nominal

GENERAL AND PHYSICAL SPECIFICATIONS

Operational Modes: Constant Voltage with adjustable current limiting; Constant Current with adjustable voltage limiting; Automatic Crossover.

Mode Indicator: Front panel mode indicator light indicates when supply is operating in the constant current or current limiting mode.

Controls:
Voltage: Coarse and Fine; 0 to rated output; front panel.
Current: Coarse and Fine; 1% I_{rated} to rated output; front panel.
Input Power: Front panel switch and indicator.

Metering:
Voltage: Front panel voltmeter.
Current: Front panel ammeter.

Terminals:
Front Panel: Pos. Output (+V) — Neg. Output (—V) — Ground (G).
Rear Panel: Pos. Output (+V) — Neg. Output (—V) — Pos. Sensing (+S) — Neg. Sensing (—S) — Ground (G) — Remote Voltage Programming (RVP) — Remote Current Programming (RIP).

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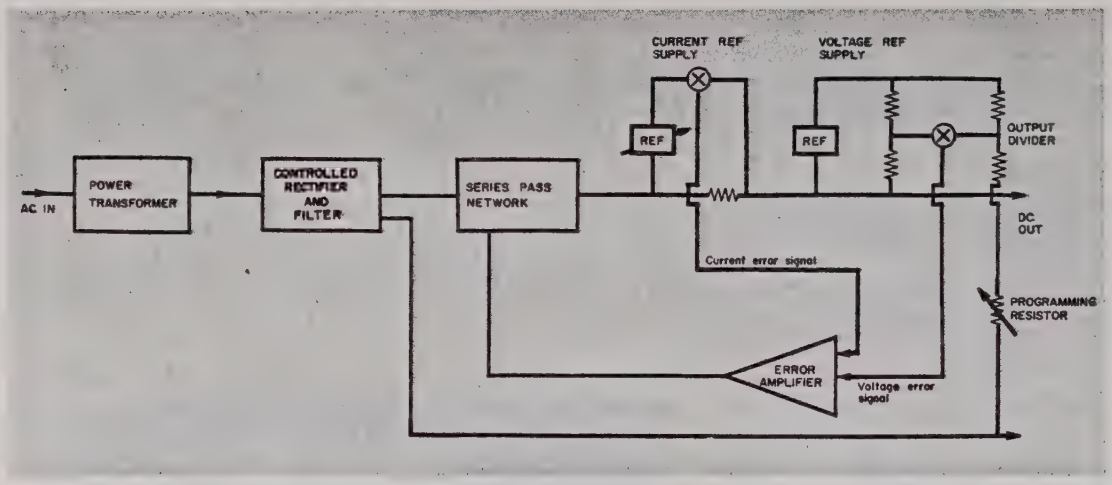


Block Diagram — Silicon Rack Series

DESCRIPTION

• The Trygon SILICON RACK SERIES units are designed for laboratory and systems applicatons. Their unique design provides operating flexibility and high reliability at high power output levels.

• CONSTANT VOLTAGE and CONSTANT CURRENT operation is provided with automatic crossover from one mode into the other. In the voltage mode, adjustable current limiting is provided while the current mode provides adjustable voltage limiting. A mode indicator light on the front panel indicates when the unit is operating in the constant current or current limiting mode. All units in this series have provisions for remote programming of voltage and current.

• MAXIMUM RELIABILITY is achieved through the use of proven design techniques, components selection, and rugged construction. High quality components are used throughout and power transistors are generously derated and temperature aged, zener diodes are temperature stabilized, electrolytic capacitors are computer grade with rated life in excess of 10 years, transformers meet or exceed the requirements of MIL-T-27A, and all Trygon power supplies are manufactured in accordance with the Quality Assurance requirements of MIL-Q-9858. The Silicon Rack Series units carry the Trygon 5 year warranty.

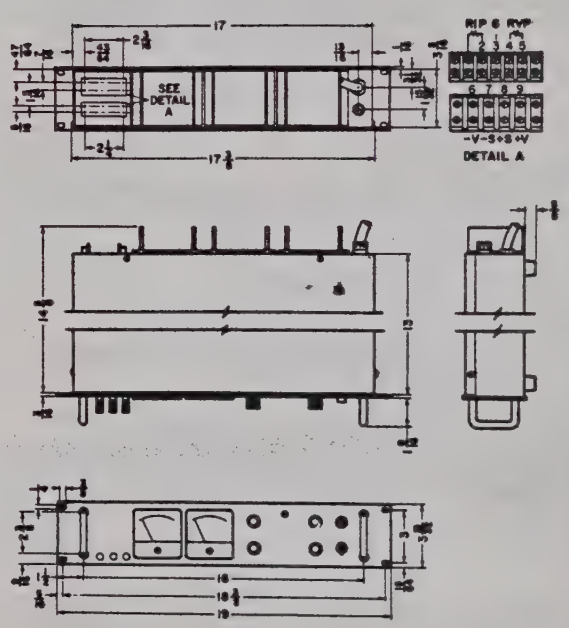
• AUTOMATIC TRACKING OVERVOLTAGE PROTECTION (OV)* is a patented automatic fail-safe overvoltage protection circuit pioneered by Trygon. The OV circuit protects the load against receiving a voltage in excess of the programmed output voltage of the supply. The protection point automatically tracks the programmed output voltage.

• SERIES OR PARALLEL OPERATION to increase voltage or current can easily be accomplished by connecting two or more supplies of this series together.

• SPECIAL MODIFICATIONS: The standard Silicon Rack RS Series units are available in five voltage ranges. Their outstanding versatility, reliability, and operating convenience make them ideally suited for a large majority of applications in standard form.

• TRYGON ELECTRONICS, INC., has available a number of standard options and modifications to extend even further the range of performance or application of each power supply. In addition, the Trygon Application Engineering department is available for consultation on specific applications.

*Optional



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SECTION II - INSTALLATION AND OPERATION

2.1 MECHANICAL INSTALLATION

2.1.1 Rack Mounting

Any standard EIA relay rack will accommodate the Trygon Silicon Rack Series power supplies in only 3 1/2 inches of vertical mounting space. Mounting of the unit is easily accomplished by inserting four mounting screws through the slotted holes provided in the four corners of the front panel of the power supply, and on into the matching threaded holes of the relay rack.

2.1.2 Bench Use

Though designed primarily as a rack mounting unit, the Silicon Rack Series power supply may be operated in a bench type configuration as well. It is therefore fully enclosed in a protective metal case, and equipped with rubber mounting feet which serve to protect the unit and the surface upon which it rests from scratching, and to provide an airflow channel under the unit for ventilation purposes.

2.2 ELECTRICAL CONNECTIONS

2.2.1 AC Input

AC input power (105-130 VAC, 47-65 CPS) is applied to a three terminal barrier strip marked AC-G-AC, mounted on the rear panel.

The power handling ability of the AC power lines feeding AC power to the line cord must be considered, as serious losses in regulation and substantial increases in ripple can occur as

2.2.1 AC Input (Cont'd)

a result of insufficient power handling capacity of these lines. The AC impedance from the breaker box to the power supply input connector should not exceed 0.75 ohms. Any movable electric contact surface (such as the wiper arm of a variable transformer) should be kept clear of impedance producing oxide coatings.

Care should be exercised in selecting the proper wire size for the AC input lines. The figures listed in Table 2-1 will serve as a guide in making this selection.

TABLE 2-1 - AC INPUT WIRE SIZE

Length of Run (Single Lead)	Wire Size (AWG Standards)
10 feet or less	14
10 feet to 20 feet	12
20 feet to 50 feet	10
50 feet to 100 feet	8

2.2.2 DC Output

Output connections are made from a special output and sensing block marked -S, +S, -V and +V, mounted on the rear panel. The load must be connected to the -V and +V terminals of this output block.

Additional output and ground connections are available in the form of binding post connectors mounted on the front panel. The output of the unit should always be taken from the rear panel output lugs and studs, and the front panel binding post connections used for monitoring purposes only.

2.2.3 Sensing

The Trygon Model RS40-10BOVX S1920 power supply is shipped with shorting links in place across terminals -S and -V,

2.2.3 Sensing (Cont'd)

and +S and +V of the DC output block. In this configuration, local sensing operation is provided. To operate in the remote sensing configuration, the shorting links between these terminals must be removed, and external sensing leads must be connected between the +S and -S terminals and the load.

2.2.4 Voltage Programming

The output voltage of the power supply may be programmed locally by means of the front panel Voltage Adjust controls, or remotely by means of a remotely located and operated Voltage Adjustment control.

To operate in a Local Voltage Programming configuration, a shorting link must be placed across rear panel barrier strip terminals 1 and 2 (RVP). The voltage output is then controlled directly by the front panel Voltage Adjust controls.

To operate in a Remote Voltage Programming configuration, the shorting link connecting rear panel barrier strip terminals 1 and 2 (RVP) must be removed, remote programming leads run from barrier strip terminals 1 and 2 (RVP) to the remote location, and a remotely controlled Voltage Adjust control connected across the remote programming leads.

The scale factor to be used for the remote Voltage Adjust control is 100 ohms per volt. In order for this remotely operated adjustment control to function properly, front panel VOLTAGE ADJUST (R85) and VOLTAGE VERNIER (R86) adjustment controls must be set fully CCW. Operation of this power supply without either shorting link or remotely operated adjustment control connected across remote voltage programming barrier strip terminals 1 and 2 (RVP), will result in an unregulated output voltage.

2.2.5 Shorting Link Connections

Shorting link connections for the various combinations of sensing and programming functions are conveniently listed in TABLE 2-2 - SHORTING LINK APPLICATION.

TABLE 2-2 - SHORTING LINK APPLICATION

SELECTION	FUNCTION	CONNECTIONS REQUIRED
1	Local Sensing and Local Programming	Short terminals -V and -S, and +V and +S of Output and Sensing Block.
2	Local Sensing and Remote Programming	Set Voltage Adjust control R85 and Voltage Vernier control R86 fully CCW. Remove shorting link between barrier strip terminals 1 and 2, and connect remote programming resistor in its place.
3	Remote Sensing and Local Programming	Short terminals 1 and 2 of barrier strip. Remove shorting links from +S and +V, and -S and -V terminals of Output and Sensing Block. Run remote sensing leads from +S and -S terminals to load.
4	Remote Sensing and Remote Programming	Open barrier strip terminals 1 and 2. Connect remote programming resistor between barrier strip terminals 1 and 2.

2.3 OPERATION

The Trygon Model RS40-10B0VX S1920 power supply is designed to provide either positive or negative DC output power when operated as an individual unit, or both positive and negative output power when operated in a Master/Slave configuration.

2.3.1 Front Panel Controls

TABLE 2-3 - FRONT PANEL CONTROLS

Symbol	Name	Function
S1	AC POWER	Power switch, controls input power.
S2	MASTER/SLAVE	Selects operating mode when two or more units are interconnected.
R85	VOLTAGE ADJUST	Potentiometer, adjusts voltage output.
R86	VOLTAGE VERNIER	Potentiometer, adjusts voltage output.
R84	CURRENT ADJUST	Potentiometer, adjusts current.
R31	CURRENT VERNIER	Potentiometer, adjusts current.

2.3.2 Internal Controls

All internal control settings have been factory preset, and require no additional adjusting. However, if it should become necessary to adjust any of the internal controls due to circuit changes caused by component aging or replacement, refer to the calibration section of this instruction manual.

2.3.3 Control Settings

Set all front panel controls fully CW so that unit will operate in the Voltage rather than Current Limiting mode.

2.3.4 Grounding

Either side of the Output may be grounded, or the Output may be used in a floating condition.

2.3.5 Power On

Connect the power supply to a suitable source of 115 VAC, 60 cycle power. Set POWER switch S1 to AC-ON, and observe that pilot lamp DS1 glows.

2.3.6 Warm-Up

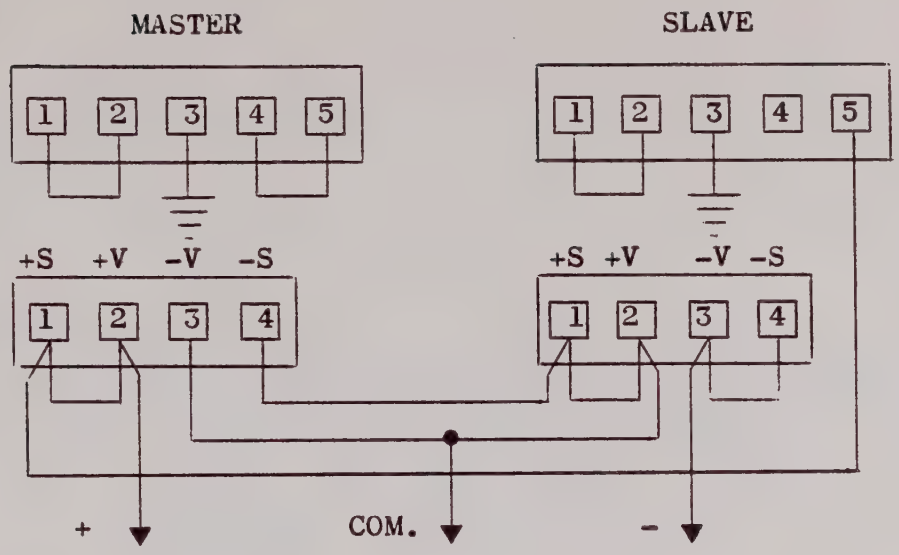
No warm-up time is necessary to place the unit into operation. However, a 30 minute warm-up period is recommended to reach rated stability.

2.4 MASTER/SLAVE TRACKING OPERATION

To operate two Trygon Model RS40-10BOVX S1920 power supplies in a Master/Slave configuration, select one unit to act as the Master unit and the other to be the Slave. Set Master unit front panel MASTER/SLAVE switch S2 to MASTER, and Slave unit front panel MASTER/SLAVE switch S2 to SLAVE. Interconnect both units as shown in Figure 2-1. When operating in this configuration, the output voltage is controlled from the Master unit.

The positive output terminal (+V) of the Master unit serves as the positive output terminal (+V) for the combined "Master/Slave power supply", the negative output terminal (-V) of the Slave unit serves as the negative output terminal of the combined "Master/Slave power supply", and the line connecting the positive output terminal (+V) of the Slave unit with the negative output terminal (-V) of the Master unit serves as the "common" point of the combined Master/Slave power supply.

FIG. 2-1

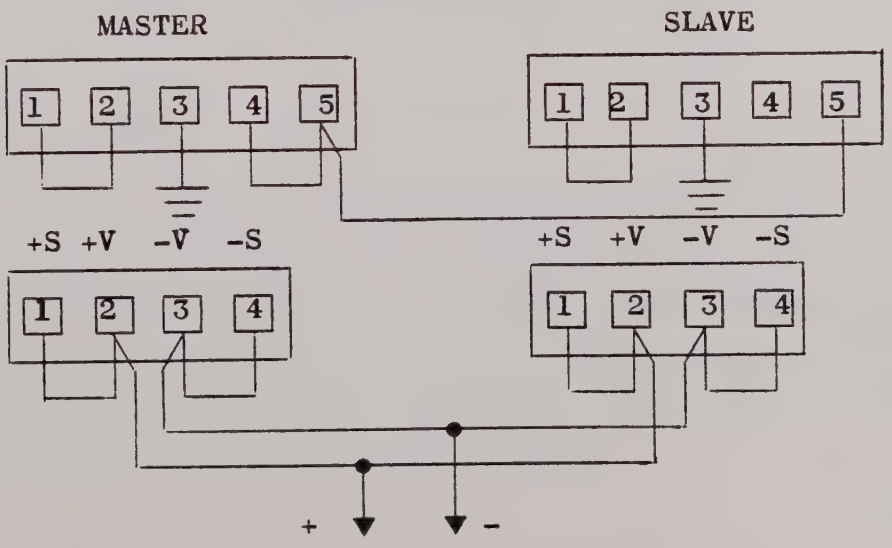


2.5 AUTO-PARALLEL CONNECTIONS

To operate two or more Trygon Model RS40-10B0VX S1920 power supplies in an Auto-Parallel configuration, select one unit to act as the Master unit and the other to be the Slave unit. Set front panel MASTER/SLAVE switch S2 on both Master and Slave units to MASTER, and Slave unit front panel VOLTAGE ADJUST controls fully CW. Interconnect units as indicated in Figure 2-2.

If remote sensing operation is desired when operating in the Auto-Parallel configuration, the remote sensing leads should be connected to the Master unit sensing terminals.

FIG. 2-2



SECTION III - THEORY OF OPERATION

3.1 GENERAL

The purpose of the Trygon Silicon Rack power supply is to transform and rectify the AC input into a well regulated, stable and adjustable DC output. In performing these functions, the circuitry of the unit may be broken down into six basic sections, which shall be referred to in the following order:

1) Primary Input
2) Reference Supply
3) Pre-Regulator
4) Series Regulator
5) Comparator
6) Error Amplifier

3.2 CIRCUIT ANALYSIS

The circuitry of this power supply has been outlined in simplified form in the Block Diagram located at the rear of this section. As each basic circuit is described, it will be advantageous to refer to the Block Diagram and the Schematic Diagram located at the rear of the Appendice Section of this instruction manual.

3.2.1 Primary Input

Input power is obtained through transformer T1, full wave rectifier diode sets CR1 and CR2, CR3, CR4, CR5 and CR6, and filter capacitors C1 and C8. Each rectifier set provides the necessary DC voltages to the various power supply sub-sections.

When switch S1 is set to ON, pilot lamp DS1 illuminates and AC power is applied to T1. Regulated DC output voltage is immediately available from the power supply.

3.2.2 Reference Supply

The rectified and filtered voltage from CR1, CR2 and C1 is pre-regulated by Zener diode CR13. This provides a stabilized DC voltage to Q2 whose output is regulated by Zener diode CR15. Q1 controls the drive to Q2 and in turn is controlled by Q2. The voltages developed across CR14 and CR15 are highly stable reference voltages established at a higher positive potential than the positive output of the supply.

3.2.3 Pre-Regulator

The purpose of the pre-regulator is to maintain the unregulated input voltage on input capacitor C8 at a suitable value compared to the output voltage in order to lower the power dissipation across the Series Pass section.

The method used to accomplish this is to "fire" a pair of SCR's (silicon controlled rectifiers) CR9 and CR10 at controlled points along the input sine wave to increase or decrease the potential to which the input capacitor may charge. The SCR's are "fired" (allowed to pass current) by the application of a positive pulse at the junction of R35 and R37 from unijunction transistor Q12.

The unijunction transistor is able to trigger the SCR's by charging C13 sufficiently to cause Q12 to conduct. The timing of Q12 to trigger the SCR's is a function of the voltage across series pass transistors Q13, Q14, Q15 and Q16 and the AC voltage referenced by CR22 and CR23 and the circuitry of R43 and R44.

The SCR's are turned off with each alternate half cycle of the input sine wave. R43 is a factory set adjustment that sets the optimum full load firing point of the SCR's.

The network composed of R51, R52, CR32 and R53 divides the total voltage developed across Series Pass transistors Q13, Q14, Q15 and Q16 in an even ratio.

3.2.4 Series Regulator (Cont'd)

these drivers causes the Series Pass transistors to act as a variable resistor in accordance with the needs of the power supply to increase or decrease the output voltage and current. The drivers in turn are controlled by Q7 in the error amplifier.

3.2.5 Comparator

The voltage sensing and comparison is accomplished by Q10 and Q11 arranged as a differential amplifier. A sample of the output voltage on the base of Q11 is compared to the reference voltage on the base of Q10. An unbalance caused by a change in output voltage or by a change in the setting of voltage adjust resistors R66 and R67 will appear as a voltage change in the collector of Q11.

3.2.6 Error Amplifier

The voltage change from Q11 is amplified by Q7 which in turn controls series pass driver Q19.

3.3 OPTIONAL FEATURES

3.3.1 Overvoltage (OV) Protection

If the output voltage should rise above the programmed output level, a portion of the signal developed across OV Sensitivity Control R90 will cause Q22 to conduct, which in turn will drive Q23 into conduction.

The purpose of this regenerative or latching action is to cause a sharp OV pulse to be applied to the gate lead of SCR CR34 in the shortest possible time, placing in effect, a short across the output of the unit. When SCR CR34 "fires" CR37 also conducts, causing through Series Pass driver Q19, a reduction in the conduction of the Series Pass circuit.

If the overvoltage condition is caused by a short in the Series Pass circuit, SCR CR34 will "fire", and fuse F2 will open.

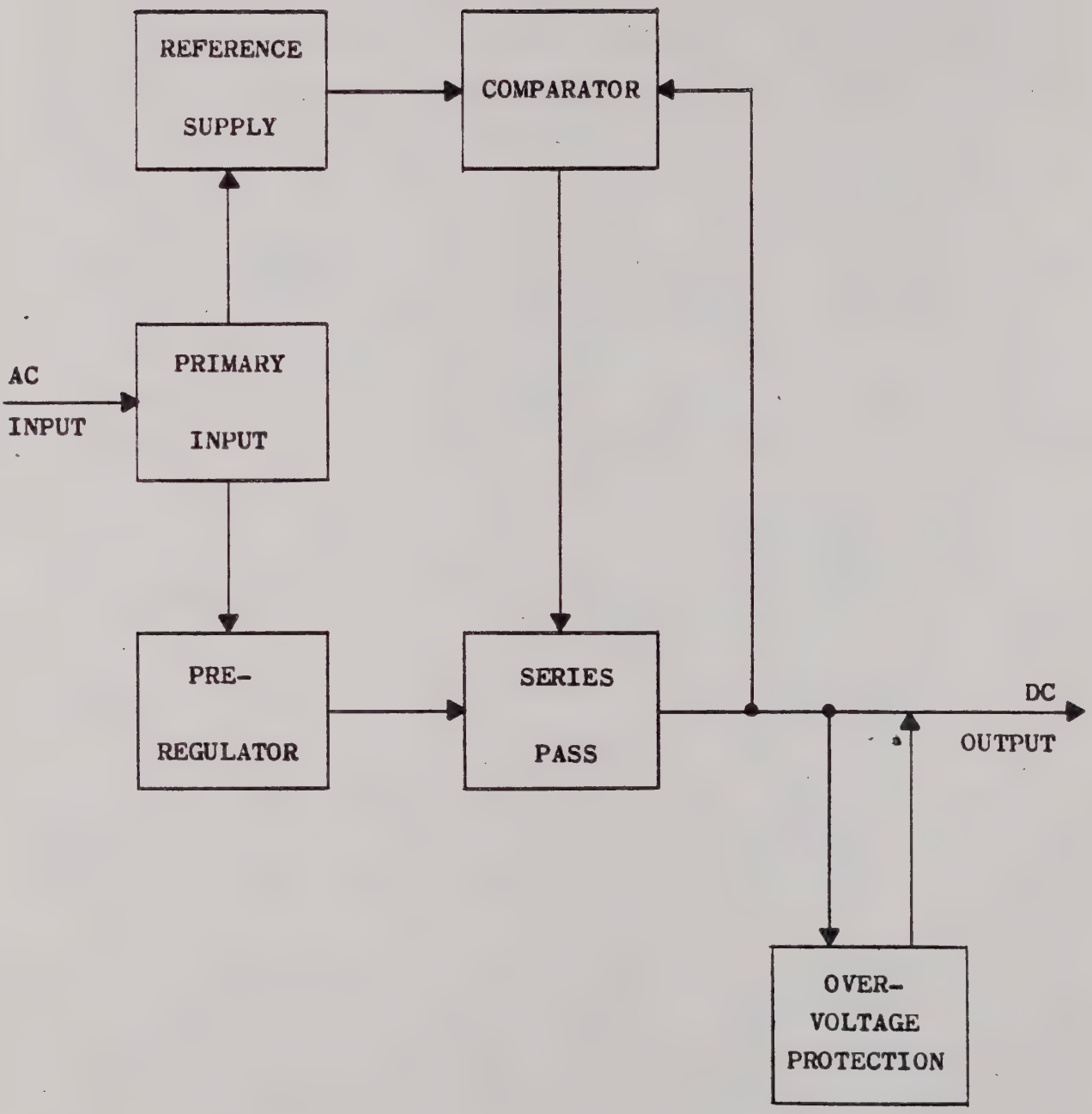


FIGURE 3-1 - BLOCK DIAGRAM

SECTION IV - MAINTENANCE

- WARNING -

High Voltages Are Present
Use Caution

4.1 GENERAL

This power supply is a precision instrument. It is strongly recommended that only experienced trouble shooting personnel perform trouble shooting operations or attempt to repair the unit. If the power supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1) Disconnect all loads and interconnections.
2) Connect a resistive load across the output terminals, and operate the unit to determine whether the fault lies within the unit or externally. Observe that Shorting Links are in place across terminals 1 and 2, 4 and 5, 6 and 7, and 8 and 9, and that all connections are tightly made.

4.3 TROUBLESHOOTING

1) Set VOLTAGE ADJUST control R66 and VOLTAGE VERNIER control R67 fully CW. Use a 20,000 ohms per volt voltmeter or oscilloscope to check the voltages across the various circuit components listed in the Troubleshooting tables of this section. Any reading

which is grossly incorrect indicates that the stage being tested or the one immediately preceding it, is defective. The Block Diagram, Schematic Diagram and appropriate sections of the Theory of Operation will prove helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily obtained from the Schematic Diagram.

2) If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point to point resistance checks across pots, switches, diodes, resistors, transistors in that order.

3) When the trouble is of an intermittent nature such as poor regulation, ripple etc., the use of an oscilloscope to determine dynamic changes will be necessary. The section on Theory of Operation should be consulted to determine circuit performance with varying output conditions.

4.3.1 Reference Supply

TABLE 4-1 REFERENCE SUPPLY

Measured Across Component	DC Voltage Reading ±10%
CR14	6.5
CR15	9.3
R5	8.6
R3	5.9
CR13	24

4.3.2 Comparator

TABLE 4-2 COMPARATOR VOLTAGES	
Measured Across Component	DC Voltage Readings ±10%
CR19	0.6
R24	6.2
R26	3.1
R33	.85
R32	2.0
R27	2.5
R29	5.0
R30	5.0
R31	6.0

SECTION V - CALIBRATION

5.1 GENERAL

The following adjustments should be made when necessary to assure optimum operating characteristics and maximum efficiency of the Trygon power supply.

5.2 TEST EQUIPMENT REQUIRED (or equivalent)

(A) Oscilloscope, Tektronix Type 561
(B) Differential Amplifier Plug In, Tektronix Type 63
(C) Time Base Plug In, Tektronix Type 67
(D) Differential VTVM, Fluke Model 825A
(E) AC VTVM, Hewlett Packard Model 400D
(F) VOM, Simpson Model 260
(G) Variable Auto transformer, Superior Elect. Co., Type 1156D (20 Ampere rating)

5.2.1 Shorting Link Application

For test purposes, shorting links should be connected between terminals +S and +V, and -S and -V of the DC Output and Sensing Block, to provide local sensing operation. To reduce pickup, shielded wire must be used for all connections between test equipment and the power supply being tested. To prevent ground loops, it is important that only one ground connection be made, as shown in Figure 5-1 and Figure 5-2. Tighten all terminal connections as securely as possible, and set all front panel controls fully CW.

5.3 CALIBRATION PROCEDURE

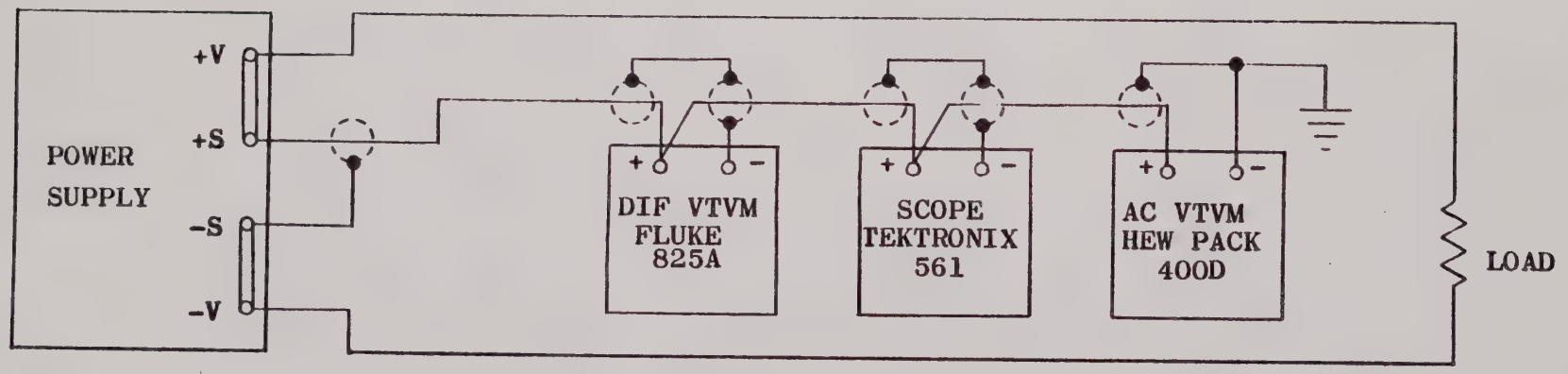


FIGURE 5-1
CONSTANT VOLTAGE OPERATION

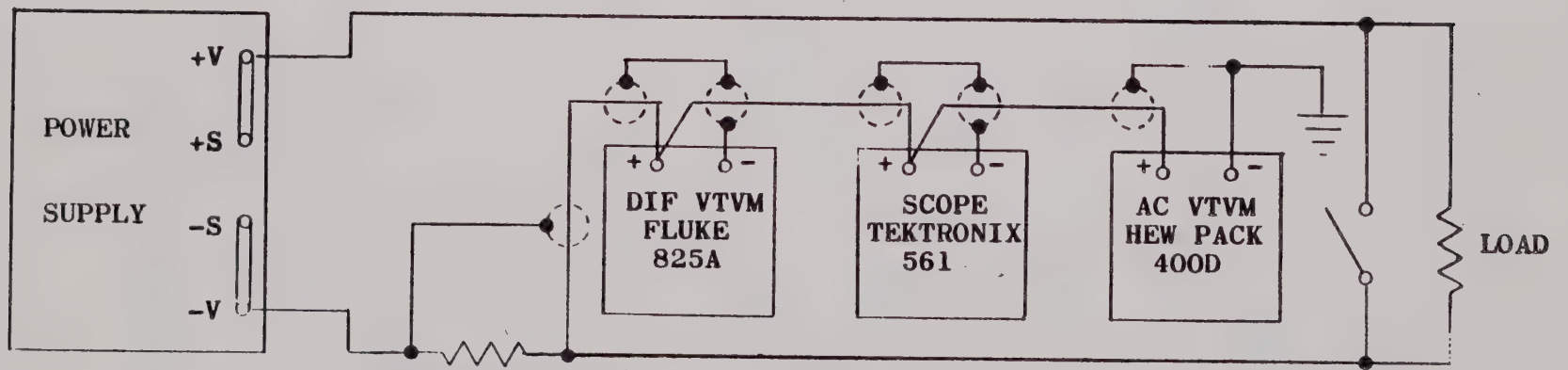


FIGURE 5-2
CONSTANT CURRENT OPERATION

5.3.1 Pre-Regulator

A) With power supply operating without a resistive load across the output terminals, vary VOLTAGE ADJUST control until 50% of rated voltage output is indicated on the D.C. voltmeter. Set POWER ON switch S1 to OFF, and connect resistive load across the output terminals. Set POWER ON switch S1 back to ON, and adjust resistive load for rated current setting on ammeter.

B) Set oscilloscope to D.C. triggering mode and connect scope input across the positive terminals of input capacitor C16 and output capacitor C9.

C) Adjust R49 for a nominal 9 VDC and a balanced 120 cps sawtooth waveshape.

D) Vary AC input line voltage between 105 and 125 VAC. Observe that the 120 cps sawtooth waveshape remains balanced and does not vary in amplitude more than 20% of the preset value (9 volt nominal).

5.3.2 Current Adjust Controls

A) Maximum Current

Connect a test ammeter having a full scale current indicating capacity of 150% that of the rated current output across the output terminals of the power supply. (Set all front panel controls fully CCW.) Apply power to the unit under test and slowly rotate CURRENT ADJUST control R84 and CURRENT VERNIER control R31 fully CW. Observe that the maximum current obtainable is approximately 120% that of the rated current output. If it is not possible to achieve 120% of the rated current output, adjust Maximum Current control R37 until that value is attained. Set AC Power Switch to OFF.

Connect a suitable load resistance across the output terminal connections. The load resistance must be able to dissipate the rated power of the unit (P = IE) and must be of sufficient value to yield the rated output current when the rated

5.3.2 Current Adjust Controls (Cont'd)

voltage is applied. Set AC Power Switch to ON. Note the voltage indicated on the Differential VTVM. Disconnect the resistive load from the output and observe the voltage indicated on the Differential VTVM. The maximum change in output voltage should not exceed by more than 0.01% or 3mv (whichever is greater) that of the output voltage indicated with the load resistance applied across the output terminals.

If it is not possible to maintain the load regulation as stated in the preceding paragraph, readjust Maximum Current control R37 slightly and recheck the load regulation. Further minor adjustment of Maximum Current control R37 may be necessary to achieve both proper load regulation and 120% of rated current output.

B) Minimum Current

Connect test ammeter, having a full scale current indicating capacity of 100ma, across output terminals in place of a load resistor. Set all front panel controls fully CCW and apply power to the unit under test. Slowly rotate VOLTAGE ADJUST control in a CW direction, until current meter indicates a current flow somewhere between 0-50ma. Adjust Minimum Current control R110 for a nominal current indication of 25ma. Set POWER ON switch S1 to OFF.

5.3.3 Constant Voltage Operation

A) Load Regulation

With the equipment connected as shown in Figure 5-1, connect a suitable load resistance across the Output terminal connections. The load resistance selected must be able to dissipate the rated power of the unit (P = EI) and must be of sufficient value to yield the rated output current when the rated voltage is applied. Note the voltage indicated on the Differential VTVM. Disconnect the resistive load from the output. The maximum

5.3.3 Constant Voltage Operation (Cont'd)

change in output DC voltage indicated on the Differential VTVM should not exceed by more than 0.01% or 3mv (whichever is greater) that of the output voltage indicated with the load resistance applied across the output terminals.

B) Line Regulation

Place the resistive load across the output and note the voltage indicated on the Differential VTVM. Vary the input line voltage between 105 and 125 VAC. The maximum change in output voltage should not exceed by more than 0.01% or 3mv (whichever is greater) that of the output voltage measured at either extreme of the AC input.

C) Ripple Voltage

In order to reduce pickup, shielded test leads should be used in making ripple measurements. With the resistive load connected across the output terminals, measure the AC ripple with the AC VTVM. Vary the input line voltage ±10% about the nominal value. The maximum ripple amplitude should not exceed 0.5mv RMS.

5.3.4 Constant Current Operation

A) Load Regulation

With the equipment turned off, disconnect the resistive load from the output terminals. Connect a small current sensing resistor in series with the resistive load and then connect the load back across the output terminals. Selection of the proper value for the current sensing resistor may be easily made, using the formula $R_S = \frac{I}{I_R}$ where R_S = Value of Current Sensing Resistor and I_R = Rated Load Current. Connect the equipment as shown in Figure 5-2, and apply power to the power supply.

Vary the VOLTAGE ADJUST controls and resistive output load as necessary, to achieve rated current and voltage output.

5.3.4 Constant Current Operation (Cont'd)

Decrease the load resistance until current meter reading exceeds full scale indication. Rotate CURRENT ADJUST control CCW to return the current meter reading to full scale. Observe that the output voltage has decreased from its previous full scale reading, and that increasing the VOLTAGE ADJUST controls has no effect upon the output voltage or current. This indicated that the unit is now operating in the Constant Current Mode.

Measure the voltage across the small sensing resistor. Compute and note the current flow through this resistor. Change the output load from the resistive load previously used, to a short. Again measure the voltage across the small sensing resistor and compute the value of the current flow through this resistor. The change in current should not exceed by more than 0.5% the rated current previously noted with a full resistive load across the output.

B) Line Regulation

Replace the resistive load across the output and measure the voltage drop across the small sensing resistor. Compute and note the current flow ($I = \frac{E}{R}$) through this resistor.

Vary the input line voltage ±10% about the nominal value. Note the maximum change in voltage across the sensing resistor and compute the maximum current flow. The maximum change in current should not exceed by more than 0.5% the rated current previously noted at either extreme of the AC input.

C) Ripple Current

With the AC input line voltage adjusted to the nominal AC input line value and the resistive load connected across the output, measure the amplitude of the AC ripple as seen across the sensing resistor with the AC VTVM. Compute and note the current flow. Vary the AC line voltage ±10% about the nominal value. Measure the maximum voltage drop and compute the

5.3.4 Constant Current Operation (Cont'd)

maximum current flow. The maximum ripple current must not exceed by more than 0.25% or 5ma (whichever is greater) that of the current flow noted during nominal input line voltage.

5.3.5 Overvoltage (OV) Sensitivity

The sensitivity of the Overvoltage Protection circuit is determined by the setting of Overvoltage Sensitivity control. This control is factory preset to cause a short circuit to be applied across the output of the unit if the output voltage attempts to rise more than 10% or 1.5 volts above the programmed voltage.

Overvoltage control R75 may be set to cause the overvoltage circuit to operate at any point between 2 VDC and 40 VDC.

The point at which R75 should be set to cause automatic shut down of the unit may be easily selected by first setting the output voltage of the power supply to the desired amplitude, and then slowly rotating R75 in a CCW direction, until the output of the unit suddenly drops to zero. Voltage adjust control R85 should then be set to some point below that selected for automatic overvoltage operation, and the unit turned off and back on again in order to reset for operation.

LIST OF ELECTRICAL PARTS - MFRS' CODE

1) The numbers designated in the SPARES column of the following LIST OF ELECTRICAL PARTS indicate the recommended spare parts requirement for support of this equipment for a period of one year.
2) For units equipped with either or both High Stability and Overvoltage options, the List of Electrical Parts pages so labeled contain appropriate additional and/or replacement parts listings.
3) The code designations listed in the MFR column of the LIST OF ELECTRICAL PARTS, have been assigned to the following manufacturers:

CODE	MANUFACTURER
A-B	ALLEN BRADLEY
BUSS	BUSS
CARL	CARLING
CD	CORNELL DUBILIER
CLAR	CLAROSTAT
CORN	CORNISH
CTS	CHICAGO TELEPHONE SUPPLY
GE	GENERAL ELECTRIC
GI	GENERAL INSTRUMENTS
HOYT	HOYT
IREC	INTERNATIONAL RECTIFIER CORP.
IRES	INTERNATIONAL RESISTOR CORP.

(T) designates Trygon drawing

CODE	MANUFACTURER
LEE	LEECRAFT
MILW	MILWAUKEE
MOTO	MOTOROLA
RCA	RADIO CORPORATION OF AMERICA
SAGE	SAGE
SANG	SANGAMO
SPRA	SPRAGUE
STEV	STEVENS
TRAN	TRANSITRON
TRY	TRYGON
UNI	UNITRODE
WL	WARD LEONARD
ARN	ARNOLD
COMA	COMARK

ERIE	ERIE
SEMC	SEMCORE
SEMT	SEMTECH

LIST OF ELECTRICAL PARTS - STANDARD UNIT

Designation	Component	MFR	Part Number	Spares	
C1	Capacitor, 950 MFD, 50V	SANG	500-1154-03	1	
C2	Capacitor, .0033 MFD, 600V	ERIE	CK62AW332M	1	
C3	Capacitor, .001 MFD, 600V	ERIE	CK62BX102M	1	
C4	Capacitor, .01 MFD, 600V	ERIE	811Z5V103P	1	
C5, 12	Capacitor, .047 MFD, 250V	COMA	MET MYLAR	1	
C6	Capacitor, .15 MFD, 250V	COMA	MET MYLAR	1	
C7	Capacitor, 30 MFD, 50V	SPRA	40D306F05DDH4	1	
C8	Capacitor, 12,400 MFD, 60V	SANG	500-1239-02	1	
C10	Capacitor, 5000 MFD, 50V	SANG	820250	1	
C11, 16	Capacitor, 10 MFD, 50V	SPRA	40D106F05DDC4	2	
C13	Capacitor, .1 MFD, 50V	GE	GE67F3R104	1	
CR1, 2, 3, 4, 5, 6, 16, 18, 19, 20, 26, 27, 28, 29, 30, 31, 36	Diode	GI	G100B	12	
CR9, 10	Rectifier, Silicon Control	MOTO	SCR285-4	2	
CR13	Diode, Zener	HOFF	IN1360A	1	
CR14	Diode, Zener	TRAN	SV515	1	
CR15	Diode, Zener	SEMC	TR2620A	1	
CR21	Diode	GI	IN4383	1	
CR22, 24	Diode, Zener	TRAN	1N753	2	
CR23	Diode, Zener	TRAN	1N751	1	

LIST OF ELECTRICAL PARTS - STANDARD UNIT

Designation	Component	MFR	Part Number	Spares	
CR25	Diode	IREC	1N1341	1	
DS1	Pilot Light	FERI	5SRH-F2-R1-N1SL	1	
DS2	Light, Ind.,	LEE	41N G6 1317 9B5T	1	
F1	Fuse	BUSS	MDL10	5	
M1	Meter, 5A Ext.	HONEY	MS 2T	1	
M2	Meter, 40V	HONEY	MS 2T	1	
P1	Cord Line, 16 3	CORN	3534		
Q1, 6, 8, 10, 11, 19	Transistor	GE	16A507	4	
Q2, 3, 4, 5, 6, 7, 20	Transistor	TRAN	TR1132	4	
Q12	Unijunction, UJ25	GE	4JX5E600	1	
Q13, 14, 17	Transistor	RCA	TR1494	3	
Q18	Transistor	GE	TR656	1	
R1	Resistor, 100Ω, 25W	IRES	2D	1	
R2, 44	Resistor, 10KΩ, .5W, 2%	IRES	RL20	2	
R3	Resistor, 274Ω, .5W, 1%	IRES	CECTO	1	

LIST OF ELECTRICAL PARTS - STANDARD UNIT

Designation	Component	MFR	Part Number	Spares	
R4	Resistor, 47KΩ, .5W, 10%	AB	RC20GF	1	
R5	Resistor, 1.18KΩ, .5W, 1%	IRES	CECTO	1	
R6	Potentiometer, 150Ω, 1.5W, 20%	CTS	110	1	
R7, 9	Resistor, 442Ω, .5W, 1%	IRES	CECTO	2	
R8	Resistor, 374Ω, .5W, 1%	IRES	CECTO	1	
R10, 31	Resistor, 604Ω, .5W, 1%	IRES	CECTO	2	
R11	Resistor, 2KΩ, 1.5W, 20%	IRES	110	1	
R12, 67	Potentiometer, 125Ω, 2W, 10%	CLAR	B1647	2	
R13	Potentiometer, 10Ω, 2W, 10%	CLAR	B2816	1	
R14	Resistor, .2Ω, 25W, 10%	IRES	2D	1	
R15, 23	Resistor, 511Ω, .5W, 1%	IRES	CECTO	2	
R16, 26, 27	Resistor, 750Ω, .5W, 1%	IRES	CECTO	2	
R17, 46	Resistor, 27KΩ, .5W, 10%	AB	RC20GF	1	
R18, 77	Resistor, 1KΩ, .5W, 1%	IRES	CECTO	2	
R19, 20, 42, 61, 62, 87	Resistor, 1KΩ, .5W, 10%	AB	RC20GF	3	
R21	Resistor, 100KΩ, .5W, 10%	AB	RC20GF	1	
R22, 47	Resistor, 10KΩ, .5W, 10%	AB	RC20GF	1	
R24	Resistor, 1.5KΩ, .5W, 1%	IRES	CECTO	1	
R25	Resistor, 1.24KΩ, .5W, 1%	IRES	CECTO	1	
R28, 36, 48	Resistor, 100Ω, .5W, 10%	AB	RC20GF	2	
R29, 30	Resistor, 3.01KΩ, .5W, 1%	IRES	CECTO	2	
R32	Resistor, 200Ω, .5W, 1%	IRES	CECTO	1	

LIST OF ELECTRICAL PARTS - STANDARD UNIT

Designation	Component	MFR	Part Number	Spares	
R33	Resistor, 85Ω, 3W, 3%	SAGE	1300S85-3	1	
R34	Resistor, 1KΩ, 2W, 10%	IRES	BWH	1	
R35, 37	Resistor, 10Ω, .5W, 10%	AB	RC20GF	1	
R39	Resistor, 500Ω, 25W	IRES	2D	1	
R41	Resistor, 220KΩ, .5W, 10%	AB	RC20GF	1	
R43	Resistor, 25KΩ, .25W, 10%	CTS	UPE200R	1	
R45	Resistor, 150KΩ, .5W, 10%	AB	RC20GF	1	
R49	Resistor, 16KΩ, .5W, 2%	IRES	BWH	1	
R54	Resistor, 47Ω, .5W, 10%	AB	RC20GF	1	
R60	Resistor, 330Ω, .5W, 10%	AB	RC20GF	1	
R63	Potentiometer, 50Ω, 1.5W, 20%	CTS	110	1	
R65	Resistor, 39.95KΩ, .5W, .5%	IRES	CECTO	1	
R64	Shunt, 5A	TRY	4855-2	1	
R66	Potentiometer, 4.5KΩ, 2W, 10%	CLAR	B4858	1	
R68	Resistor, 51KΩ .5W, 2%	IRES	RL20	1	
R55, 69	Resistor, .2Ω, 3W, 10%	CLAR	CC3D	2	
R71	Resistor, 820Ω, .5W, 10%	AB	RC20GF	1	
R74	Resistor, 1.5KΩ, .5W, 1%	IRES	CECTO	1	
R75	Potentiometer, 5KΩ, 1.5W, 20%	CTS	110	1	
R76	Resistor, 10MΩ, .5W, 10%	AB	RC20GF	1	
R78	Resistor, 800Ω, 5W, 5%	WL	5XM	1	
R79	Resistor, 220Ω, .5W, 10%	AB	RC20GF	1	
R86	Resistor, 29.95KΩ, .5W, 5%	IRES	CECTO		

LIST OF ELECTRICAL PARTS - STANDARD UNIT

Designation	Component	MFR	Part Number	Spares	
S1	Switch, DPST	CARL	NST52K	1	
T1	Transformer RT40-5	TRY	C4728A	1	

LIST OF ELECTRICAL PARTS - HIGH STABILITY

Designation	Component	MFR	Part Number	Spares	
CR14	Diode, Zener	TRAN	SV516	1	
CR15	Diode	SEMC	1N2166	1	
CR36	Diode	GI	G100B	1	
Q10	Transistor	GE	TR1000	1	
R24	Resistor, 1.5KΩ, 3W, 3%	SAGE	1300S1500-3	1	
R3	Resistor, 250Ω, 3W, 3%	SAGE	1300S250-3	1	
R5	Resistor, 1.18KΩ, 3W, 3%	SAGE	1300S1180-3	1	
R26,27	Resistor, 750Ω, 3W, 3%	SAGE	1300S750-3	2	
R31	Resistor, 625Ω, 3W, 3%	SAGE	1300S625-3	1	
R32	Resistor, 200Ω, 3W, 3%	SAGE	1300S200-3	1	

LIST OF ELECTRICAL PARTS - OVERVOLTAGE

Designation	Component	MFR	Part Number	Spares	
C14	Capacitor, .15 MFD, 250V	COMA	MET MYLAR	1	
CR33	Diode	GI	E016	1	
CR34	Rectifier, Silicon Control	MOTO	93-3	1	
CR35, 38, 39	Diode	GI	G100B	4	
CR37	Diode	IREC	1N1341	1	
F2	Fuse	BUSS	AGC 7.5	5	
Q22	Transistor	GE	16A507	1	
Q21	Transistor	MOTO	TR2905	1	
R81	Resistor, 12KΩ, .5W, 2%	IRES	RL20	1	
R82	Resistor, 700Ω, 3W, 3%	SAGE	1300S700-3	1	
R84	Potentiometer, 5KΩ, 1.5W, 20%	CTS	BL24780	1	
R85	Resistor, 1.18KΩ, 3W, 3%	SAGE	1300S1180-3	1	
R83	Resistor, 1KΩ, .5W, 10%	AB	RC20GF102K	1	

LIST OF ELECTRICAL PARTS - HIGH STABILITY					
Designation	Component	MFR	Part Number	Spares	
CR14	Diode, Zener	TRAN	SV516	1	
CR15	Diode	SEMC	1N2166	1	
CR36	Diode	GI	G100B	1	
Q10	Transistor	GE	TR1000	1	
R24	Resistor, 1.5KΩ, 3W, 3%	SAGE	1300S1500-3	1	
R3	Resistor, 250Ω, 3W, 3%	SAGE	1300S250-3	1	
R5	Resistor, 1.18KΩ, 3W, 3%	SAGE	1300S1180-3	1	
R26,27	Resistor, 750Ω, 3W, 3%	SAGE	1300S750-3	2	
R31	Resistor, 625Ω, 3W, 3%	SAGE	1300S625-3	1	
R32	Resistor, 200Ω, 3W, 3%	SAGE	1300S200-3	1	

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PART NO	DESCRIPTION		BM NO	S/A	UQTY
00000	RS40 5	EV F	40300	00	1
					1
00000	FRONT PANEL ASSY RS40 5		40300	021	1
049258 -	COVER SUPPORT		40300	021	1
065381 -	PANEL RS 385 FINISHED 065380		40300	021	1
500010 -	POT 10 2 W10	5281	40300	021	1
	R 13				
500060 -	POT 125 2 W10	8154	40300	021	2
	R 12 67				
500279 -	POT 495K 2W 10		40300	021	1
	R 66				
520576 -	RMF 29895K 85W85 CECTO		40300	021	1
065043-01	R 86				
[redacted] -	METER 5A EXT [redacted] *MS2T 10-3-77*		40300	021	1
065072-02	M 001				
[redacted]	METER 40V [redacted] *MS2T 10-3-77*		40300	021	1
	M 002				
770020 -	PILOT LIGHT 55RH F2 R1 NISL		40300	021	1
	DS 01				
770223 -	LIGHT IND		40300	021	1
	DS 02				
830030 -	SWITCH DPST NST52K		40300	021	1
	S 01				
920040 -	HANDLE 5476		40300	021	2
920100 -	KNOB NO INSERT RB700		40300	021	4
920150 -	POST BINDING BLACK DF21BC		40300	021	1
920160 -	POST BINDING RED DF21RC		40300	021	1
920170 -	POST BINDING WHITE DF21WTC		40300	021	1
					22
00000	CHASSIS ASSY RS40 5		40300	101	1
046400 -	CHASSIS	E4640	40300	101	1
045598 -	CLAMP CAPACITOR		40300	101	2
505515 -	XFORMER RT40 5.	C4728	40300	101	1
	T 01				
510170 -	RCOMP 3208 85 W108	RC2	40300	101	1
	R 71				
540496 -	RWW 600 5W 5 5X		40300	101	1
	R 78				
550046 -	RWW 082 25W 10 20	0	40300	101	1
	R 14				
550520 -	RWW 100 25 W	2	40300	101	1
	R 001				
650660 -	RWW 500 25 W	2	40300	101	1
	R 39				
720129 -	DIODE [redacted] *IN1199A - IN3615 (6-18-73)*		40300	101	1
	CRD 25				
820051 -	CAP 950MF 50VS00 1154 03W MYLAR		40300	101	1
	C 01				
820250 -	CAP 500MF 50V		40300	101	1
	C 010				
820340 -	CAP 1 2400MF 60V 500 1239 02		40300	101	1
	C 08				
840190 -	FEET RUBBER B42096 W		40300	101	4

PART NO	DESCRIPTION	BM NO	S/A	UQTY
850033 -	STRIP TERM 3 170	40300	101	2
900068 -	BRACKET CAPACITOR 1150580 5	40300	101	1
900070 -	BRACKET CAP 06	40300	101	1
942017 -	CABLE HARNESS AC	40300	101	1
942018 -	CABLE HARNESS DC	40300	101	1
				24
640100 -	COVER D40100	40300	108	1
				1
781144 -	NAMEPLATE RS40 5 C4752	40300	109	1
970370 -	SCREW PIND 10 32X 2850 0	40300	109	2
970665 -	SCREW HEX &250 20X1&750	40300	109	4
990000 -	WASHER 600	40300	109	4
990355 -	WASHER FIBRE 25 25X&28 1X&062	40300	109	8
				19
500000	ZENER DIODE ASSY RS20 7&5	40300	111	1
048290 -	BRACKET TRANSISTOR D48290	40300	111	1
720241 -	DIODE ZENER IN 1360A	40300	111	1
	CR013			
				3
800000	INPT PLT ASY LINE CORD RS40 5	40300	121	1
246500 -	PLATE INPUT E46500	40300	121	1
840200 -	HOLDER FUSE 342004	40300	121	1
830000 -	BUSHING STRAIN REL 6R1	40300	121	1
[redacted] -	CORD LINE 3534 16 3	40300	121	1
920990	P 01 (5-16-74)			
				5
870200 -	FUSE MDL10	40300	129	1
	F 01			
				1
000000	OUTPUT PLATE ASSY RSJ0 5	40300	131	1
871370 -	PLATE OUTPUT	40300	131	1
800147 -	CAP &047 250V	40300	131	2
	C 105 12			
810010 -	CAP 10MF 50V 40D106F050DC4	40300	131	2
	C 111 16			
850049 -	STRIP BARR 601 2109 4 C4746 4	40300	131	1
851105 -	STRIP BARRIER 67OY 5	40300	131	1
				8
840216 -	LINK SHORTING 501J	40300	139	4
850110 -	LUG SOLDER 2101 06 00	40300	139	3
				7
048380 -	HEATSINK 4938 0	40300	141	1
[redacted] -	SCR [redacted] MCR649C-4	40300	141	2
720300	CR 09 10 (6-16-71)			
				3
830070 -	SOCKET TRANSIST 133 32 10 013	40300	149	2
990290 -	WASHER MICA	40300	149	2
				4

PART NO	DESCRIPTION	BM NO	S/A	QTY
	R 04			
610350	- RCOMP 10 08 K &5 W10 RC2	40300	173	1
	R 21			
610360	- RCOMP 15 08 K &5 W10 RC2	40300	173	1
	R 45			
610500	- RCOMP 22 08 K &5 W10 RC2	40300	173	1
	R 41			
611135	- RCOMP 4&7 ME G&5W 10 -	40300	173	1
	R 076			
620070	- RMF 200 &5 W 1 CE CT	40300	173	1
	R 32			
620095	- RMF 274 &5W 0	40300	173	1
	R 03			
620135	- RMF 374 &5W	40300	173	1
	R 02			
620155	- RMF 442 &5W	40300	173	2
	R 07 09			
620180	- RMF 511 &5 W 1 CE CT	40300	173	2
	R 23 15			
620210	- RMF 604 &5 W 1 CE CT	40300	173	2
	R 31 10			
620250	- RMF 750 &5 W 1 CE CT	40300	173	3
	R 27 26 16			
620300	- RMF 1 K &5 W 1 CE CT	40300	173	2
	R 18 77			
620320	- RMF 1&18 K &5 W 1 CE CT	40300	173	1
	R 05			
620340	- RMF 1&24 K &5 W 1 CE CT	40300	173	1
	R 25			
620360	- RMF 1&5 K &5 W 1 CE CT	40300	173	1
	R 24			
620480	- RMF 3&01 K &5 W 1 CE CT	40300	173	2
	R 29 30			
620610	- RMF 01 08 K &5 W 2 RL 20	40300	173	2
	R 02 44			
620630	- RMF 01.5K &5 W 2 RL 20	40300	173	1
	R 49			
620700	- RMF 07 9&95 K &5 W &5 CE CT	40300	173	1
	R 65			
620720	- RMF 51 K &5W 2 RL 20	40300	173	1
	R 68			
630240	- RLTC 8.56 3& W 3& 1300	40300	173	1
	R 33			
640500	- RWW 1 K 2 W10 B WH	40300	173	1
	R 34			
[redacted]	- TRANSISTOR [redacted] 2N2906A	40300	173	7
705067	Q 06 07 02 03 04 (6-18-73)			
	Q 05 20			
[redacted]	- TRANSISTOR [redacted] 2N3440	40300	173	1
700205	Q 18 (6-18-73)			
700180	- TRANSISTOR 16 A5 07 - 2N2714	40300	173	5
	Q 10 11 03 09 01 (6-18-73)			
	Q 19			
[redacted]	- DIODE ZENER [redacted] 1N823	40300	173	1
720401	CR 14 (6-18-73)			

PART NO	DESCRIPTION		BM NO	S/A	QTY
720145	- UNIJUNCTION UJ25 4JX5E600		40300	173	1
	Q 12				
720181	- DIODE ZENER IN751A		40300	173	1
	CR 23				
720192	- DIODE ZENER IN753A		40300	173	2
	CR 22 24				
[redacted]	- DIODE ZENER [redacted] IN2163A		40300	173	1
720262	CR 15	(6-18-73)			
720354	- DIODE IN4384		40300	173	18
	CR 01 00 20 03 00 40 05				
	CR 06 01 60 18 01 90 20				
	CR 21 02 60 27 02 80 29				
	CR 30 03 10 35				
800006	- CAP &00 1MF 60 DV		40300	173	1
	C 03				
800025	- CAP &00 3MF 60 DV CKE2AW332		40300	173	1
	C 02				
800090	- CAP &01 MF 600V 811Z5V103P		40300	173	1
	C 04				
800177	- CAP &1 MF 50V GE67F3R104		40300	173	1
	C 13				
800210	- CAP &15 MF 25 DV MET MYLAR		40300	173	1
	C 06				
810050	- CAP 30 MF 5 DV 40D306FD50DH4		40300	173	1
	C 07				
					97
[redacted]	- SHUNT 5A RS	4855-4	40300	179	1
048554	R 64				
					1
					218

B/M CHANGES DATE 6/01/71 PAGE

PART NO	DESCRIPTION	BM NO	S/A	QTY	
0 00 00	RS 40 5A OV MOD EV F	40 302 00		1	
				1	
					942016 - HARNESS OV
0 28 72 8 -	BRACKET B2872	40 302 101		2	
				2	
6 00 00	OV BOARD NO 1 RS 40 5A	40 302 193		1	
0 77 24 8 -	BOARD OV	40 302 193		1	
6 00 28 0 -	POT 5 K 1% 5 W 2 0 BL 2478	40 302 193		1	
	R 84				
6 10 18 0 -	RCOMP 1K .5W 10%	40 302 193		2	
	R 0 83 0 87				
6 20 62 0 -	RMF 1 2K 2 5W 2 RL 20	40 302 193		1	
	R 81				
6 30 37 0 -	RLTC 7 0 0 6 3 8 W 3 8 1 3 0 0	40 302 193		1	
	R 82				
6 30 40 0 -	RLTC 1 8 1 8 K 3 8 W 3 8 1 3 0 0	40 302 193		1	
	R 85				
[redacted] -	TRANSISTOR [redacted] 2N2905A	40 302 193		1	
7 00 50 7	Q 21 (6-18-73)				
7 00 18 0 -	TRANSISTOR 1 6 A 5 0 7 - 2N2714	40 302 193		1	
	Q 22 (6-18-73)				
7 20 12 9 -	DIODE [redacted] IN1199A - IN3615	40 302 193		1	
	CR 0 37 (6-18-73)				
7 20 29 0 -	SCR MCR649AP-3 SCR 93 3 0	40 302 193		1	
	CR 34 (6-18-73)				
7 20 39 4 -	DIODE ZENER IN4384 0	40 302 193		3	
	CR 38 3 5 39				
8 00 21 0 -	CAP 0 1 5 MF 2 5 0 V MET MYLAR	40 302 193		1	
	C 1 15				
				16	
8 30 07 0 -	SOCKET TRANSIST 1 3 3 3 2 1 0 0 1 3	40 302 199		1	
8 40 07 0 -	CLIP FUSE 4051	40 302 199		2	
8 70 08 0 -	FUSE AGC 7 8 5	40 302 199		1	
	F 02				
				4	
				23	

SECTION III - THEORY OF OPERATION

3.1 GENERAL

The purpose of the Model RS40-10B0VX S1920 power supply is to transform and rectify the AC input into a well regulated, stable and adjustable DC output. In performing these functions, the circuitry of the unit may be broken down into six basic sections, which shall be referred to in the following order:

1) Primary Input
2) Reference Supply
3) Pre-Regulator
4) Series Regulator
5) Comparator
6) Error Amplifier

3.2 CIRCUIT ANALYSIS

The circuitry of this power supply has been outlined in simplified form in the Block Diagram located at the rear of this section. As each basic circuit is described, it will be advantageous to refer to the Block Diagram and the Schematic Diagram located at the rear of the Appendice Section of this instruction manual.

3.2.1 Primary Input

Input power is obtained through transformer T1 and T2, full wave rectifier diode sets CR1 and CR2, CR3, CR4, CR5 and CR6, CR26 and CR27, and filter capacitors C1, C16 and C17. Each rectifier set provides the necessary DC voltages to the various power supply sub-sections.

When switch S1 is set to ON, pilot lamp DS1 illuminates and AC power is applied to T1 and T2. Regulated DC output voltage is immediately available from the power supply.

3.2.2 Reference Supply

The rectified and filtered voltage from CR1, CR2 and C1 is pre-regulated by zener diode CR12. This provides a stabilized DC voltage to Q2 whose output is regulated by zener diode CR14. Q1 controls the drive to Q2 and in turn is controlled by Q2. The voltages developed across CR14 and CR13 are highly stable reference voltages established at a higher positive potential than the positive output of the supply.

3.2.3 Pre-Regulator

The purpose of the pre-regulator is to maintain the unregulated input voltage on input capacitor C16 at a suitable value compared to the output voltage in order to lower the power dissipation across the Series Pass section.

The method used to accomplish this is to "fire" a pair of SCR's (silicon controlled rectifiers) CR7 and CR8 at controlled points along the input sine wave to increase or decrease the potential to which the input capacitor may charge. The SCR's are "fired" (allowed to pass current) by the application of a positive pulse at the junction of R55 and R56 from unijunction transistor Q11.

The unijunction transistor is able to trigger the SCR's by charging C3 sufficiently to cause Q11 to conduct. The timing of Q11 to trigger the SCR's is a function of the voltage across series pass transistors Q16, Q17, Q10 and Q15 and the voltage referenced by CR10 and CR11 and the circuitry of R48 and R49.

The SCR's are turned off with each alternate half cycle of the input sine wave. R49 is a factory set adjustment that sets the optimum full load firing point of the SCR's.

3.2.4 Series Regulator

The pre-regulated DC voltage from the SCR's is directed through Series Pass transistors Q16, Q17, Q10 and Q15 whose

3.2.4 Series Regulator (Cont'd)

conduction is controlled by drivers Q14, Q13 and Q21. Conduction of these drivers causes the Series Pass transistors to act as a variable resistor in accordance with the needs of the power supply to increase or decrease the output voltage and current. The drivers in turn are controlled by Q6 in the error amplifier.

3.2.5 Comparator

The voltage sensing and comparison is accomplished by Q9A and Q9B arranged as a differential amplifier. A sample of the output voltage on the base of Q9B is compared to the reference voltage on the base of Q9A. An unbalance caused by a change in output voltage or by a change in the setting of voltage adjust resistors R85 and R86 will appear as a voltage change in the collector of Q9B.

3.2.6 Error Amplifier

The voltage change from Q9B is amplified by Q6 which in turn controls series pass driver Q21.

3.2.7 Overvoltage (OV) Protection

If the output voltage should rise above the programmed output level, a portion of the signal developed across OV Sensitivity Control R75 will cause Q24 to conduct, which in turn will drive Q25 into conduction. The output of Q25 is applied to the gate lead of SCR CR39, causing it to "fire" and place a short across the output. At the same time, the output of Q23 is applied to Series Pass driver Q21, which reduces conduction of the Series Pass transistors.

If the Reference Supply voltage should become unregulated, Q23 will conduct and in turn will drive Q25 into conduction.

3.3.1 Overvoltage (OV) Protection (Cont'd)

If the overvoltage condition is caused by a short in the Series Pass circuit, SCR CR39 will "fire" and fuse F2 will open.

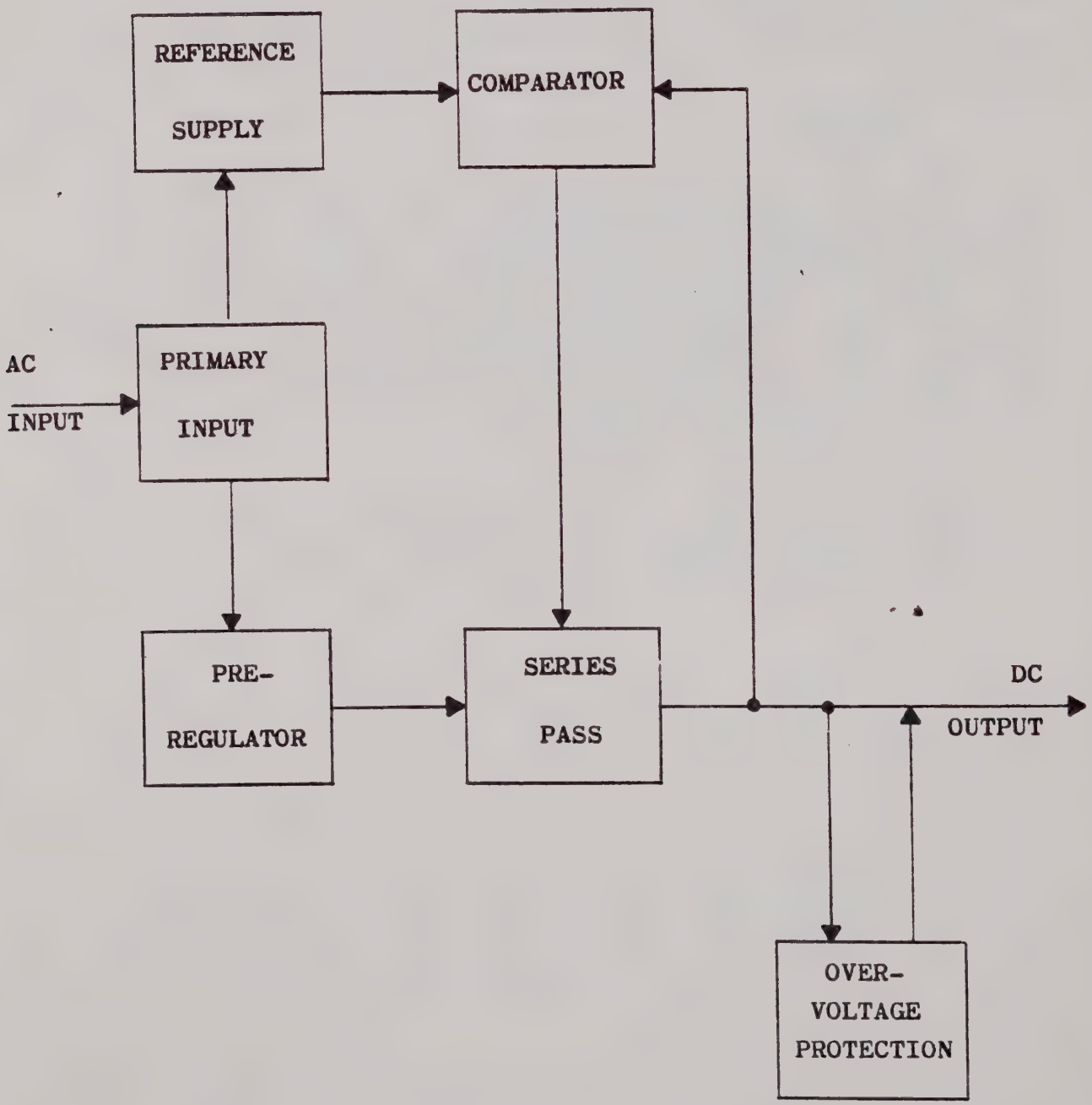


FIGURE 3-1 - BLOCK DIAGRAM

SECTION IV - MAINTENANCE

- WARNING -

High Voltages are Present

Use Caution

4.1 GENERAL

This power supply is a precision instrument. It is strongly recommended that only experienced troubleshooting personnel perform troubleshooting operations or attempt to repair the unit. If the power supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1) Disconnect all loads and interconnections.

2) Connect a resistive load across the output terminals, and operate the unit to determine whether the fault lies within the unit or externally. Observe that shorting links are in place across terminals -S and -V, and +S and +V of the DC output block, to provide local sensing operation.

3) Set input voltage to nominal value (115 VAC) and operating controls for rated output. Satisfactory operation at this time would indicate that any malfunction previously encountered is external in nature. All interconnections and loads normally used in conjunction with this power supply should then be carefully checked for electrical defects.

4.3 TROUBLESHOOTING

1) Set VOLTAGE ADJUST control R85 and VOLTAGE VERNIER control R86 fully CW. Use a 20,000 ohms per volt voltmeter or oscilloscope to check the voltages across the various circuit components listed in the TROUBLESHOOTING GUIDE, located immediately before the schematic diagram at the rear of this instruction manual. The sample voltages listed in this guide apply only if the unit is operating at its nominal AC input, and has a dummy load of sufficient size connected across its output to allow operation at maximum rated current and voltage output levels. Any reading which is grossly incorrect indicates that the stage being tested or the one immediately preceding it, is defective. The Block Diagram, Schematic Diagram and appropriate sections of the Theory of Operation will prove helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily obtained from the Schematic Diagram.

2) If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point to point resistance checks across pots, switches, diodes, resistors, transistors in that order.

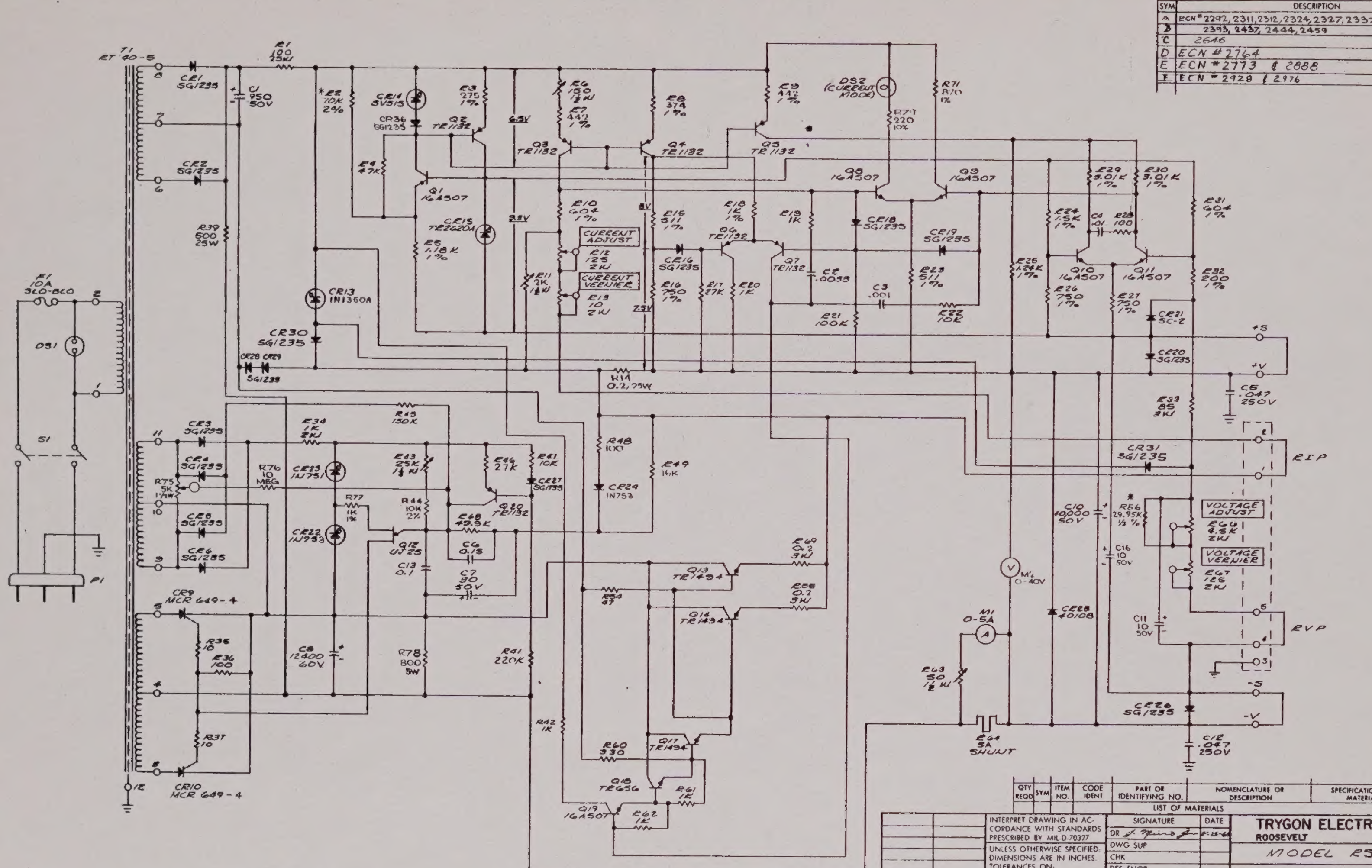
3) When the trouble is of an intermittent nature such as poor regulation, ripple etc., the use of an oscilloscope to determine dynamic changes will be necessary. The section on Theory of Operation should be consulted to determine circuit performance with varying output conditions.

A D D E N D U M

With the exception of special customer requirements listed below, all information contained in this instruction manual is applicable to Trygon Model RS40-5A/208 is similiar to the standard RS40-5A except for this difference.

I. 208 Volts input.

SYM	REVISIONS DESCRIPTION	DATE	APPD
A	ECN# 2292, 2311, 2312, 2324, 2327, 2337	11164	
B	2393, 2437, 2444, 2459	12164	
C	2646	7/5/65	BDP
D	ECN #2764	12-9-65	WW
E	ECN #2773 & 2888	12-24-65	WW
F	ECN #2928 & 2976	7-27-66	



T1 RT 40-5
F1 10A 3LO-6LO
DS1
S1
P1
CR1 SG1235
CR2 SG1235
C1 950 50V
R1 100 25W
R39 500 25W
*R2 10K 2%
CR14 3V515
CR36 SG1235
R4 47K
R3 275 1%
Q2 TR1132
Q1 1GA507
CR15 TR2G20A
R5 1.18K 1%
R6 150 1/2W
R7 442 1%
Q3 TR1132
R8 374 1%
Q4 TR1132
R9 442 1%
Q5 TR1132
DS2 (CURRENT MODE)
R71 R10 1%
R7.1 220 10%
Q8 1GA507
Q9 1GA507
R10 604 1%
CURRENT ADJUST
R12 125 2W
CURRENT VERNIER
R13 10 2W
R11 2K 1/2W
R15 511 1%
CR16 SG1235
R16 750 1%
R17 27K
R18 1K 1%
Q6 TR1132
R20 1K
R19 1K
Q7 TR1132
C2 .0033
CR18 SG1235
CR19 SG1235
R23 511 1%
C3 .001
R21 100K
R22 10K
R14 0.2, 25W
R29 3.01K 1%
R30 3.01K 1%
R24 1.5K 1%
C4 .01
R28 100
R25 1.24K 1%
Q10 1GA507
Q11 1GA507
R26 750 1%
R27 750 1%
R31 604 1%
R32 200 1%
CR21 SC-2
CR20 SG1235
R33 85 3W
+S
+V
C5 .047 250V
CR31 SG1235
RIP
CR13 1N1360A
CR30 SG1235
CR28 CR29 SG1235
CR3 SG1235
CR4 SG1235
R75 5K 1/2W
R76 10 MEG
CR5 SG1235
CR6 SG1235
R34 1K 2W
CR23 1N751
R45 150K
R43 25K 1/2W
R46 27K
R41 10K
CR27 SG1235
R77 1K 1%
R44 10K 2%
Q20 TR1132
R68 49.9K
CR22 1N753
Q12 UJ25
C6 0.15
C13 0.1
C7 30 30V
R48 100
CR24 1N753
R49 16K
CR9 MCR 649-4
CR10 MCR 649-4
R35 10
R36 100
R37 10
C8 12400 60V
R78 800 5W
R41 220K
R42 1K
R69 0.2 3W
R58 0.2 3W
Q13 TR1494
Q14 TR1494
R59 47
R60 330
Q17 TR1494
Q18 TR656
Q19 1GA507
R61 1K
R62 1K
C10 10000 50V
C16 10 50V
M2 0-40V
M1 0-5A
CR28 40108
R63 50 1/2W
R64 5A SHUNT
*R56 29.95K 1/2%
VOLTAGE ADJUST
R64 4.5K 2W
VOLTAGE VERNIER
R67 125 2W
C11 10 50V
RVP
-S
-V
CR26 SG1235
C12 .047 250V

NOTE:
ALL SG1235 DIODES ARE REPLACED BY G100B

NOTE
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, 1/2 WATT.
ALL CAPACITORS ARE IN MICROFARADS.
2. SELECT AT TEST.

QTY REQD	SYM	ITEM NO.	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION OR MATERIAL	REF DESIG

LIST OF MATERIALS

USED ON	NEXT ASSY
APPLICATION	
FINISH:	

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-D-70327
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRACTIONS ± DECIMALS ± ANGLES ±
MATERIAL

SIGNATURE	DATE
DR [signature]	9-15-64
DWG SUP	
CHK	
DES ENGR	
ENGR	
ENGR	
PROJ	
APPD.	

TRYGON ELECTRONICS INC.
ROOSEVELT NEW YORK

MODEL RS 40-5A

SCHEMATIC

CODE IDENT NO.	SIZE		REV
09206	D	4955	F

SCALE ~ SHEET 1 OF 1

MP MASTER
MA34157